New Hampshire Volunteer Lake Assessment Program

2003 Interim Report for Highland Lake Stoddard

NHDES
Water Division
Watershed Management Bureau
29 Hazen Drive
Concord, NH 03301

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

OBSERVATIONS & RECOMMENDATIONS

After reviewing data collected from **HIGHLAND LAKE (North Station, South Station) STODDARD,** the program coordinators have made the following observations and recommendations:

Thank you for your continued hard work sampling the lake/pond this season! Your monitoring group sampled **four** times this season and has done so for many years! As you know, with multiple sampling events each season, we will be able to more accurately detect changes in water quality. Keep up the good work!

FIGURE INTERPRETATION

- **Figure 1 and Table 1:** The graphs in Figure 1 (Appendix A) show the historical and current year chlorophyll-a concentration in the water column. Table 1 (Appendix B) lists the maximum, minimum, and mean concentration for each sampling season that the lake/pond has been monitored through the program.

  Chlorophyll-a, a pigment naturally found in plants, is an indicator of the algal abundance. Because algae are usually microscopic plants that contain chlorophyll-a, and are naturally found in lake ecosystems, the chlorophyll-a concentration measured in the water gives an estimation of the algal concentration or lake productivity. **The mean (average) summer chlorophyll-a concentration for New Hampshire's lakes and ponds is 7.02 mg/m^3.**

  NORTH STATION
  The current year data (the top graph) show that the chlorophyll-a concentration ***increased*** from June to August, and then ***decreased*** in September. The chlorophyll-a concentration for all four months was ***less than*** the state mean.

The historical data (the bottom graph) show that the 2003 chlorophyll-a mean is ***less than*** the state mean. Specifically, since monitoring began in 1988, the chlorophyll has ranged between approximately 3.3 and 9.5 mg/m^3.

SOUTH STATION
The current year data (the top graph) show that the chlorophyll-a concentration ***remained stable*** at approximately 4 mg/m^3 from June to September, except for a slight decrease to approximately 2 mg/m^3 in July. The chlorophyll-a concentration in all four months was ***less than*** the state mean.

The historical data (the bottom graph) show that the 2003 chlorophyll-a mean is ***less than*** the state mean.

While algae are naturally present in all lakes/ponds, an excessive or increasing amount of any type is not welcomed. In freshwater lakes/ponds, phosphorus is the nutrient that algae depend upon for growth. Algal concentrations may increase with an increase in nonpoint sources of phosphorus loading from the watershed, or in-lake sources of phosphorus loading (such as phosphorus releases from the sediments). Therefore, it is extremely important for volunteer monitors to continually educate residents about how activities within the watershed can affect phosphorus loading and lake/pond quality.

- **Figure 2 and Table 3:** The graphs in Figure 2 (Appendix A) show historical and current year data for lake/pond transparency. Table 3 (Appendix B) lists the maximum, minimum and mean transparency data for each sampling season that the lake/pond has been monitored through the program.

  Volunteer monitors use the Secchi-disk, a 20 cm disk with alternating black and white quadrants, to measure water clarity (how far a person can see into the water). Transparency, a measure of water clarity, can be affected by the amount of algae and sediment from erosion, as well as the natural colors of the water. **The mean (average) summer transparency for New Hampshire's lakes and ponds is 3.7 meters.**

  NORTH STATION
  The current year data (the top graph) show that the in-lake transparency ***remained stable*** from June to September. The transparency in June, July, August, and September was ***greater approximately equal to but less than*** the state mean.

The historical data (the bottom graph) show that the 2003 mean transparency is ***less than*** the state mean.

SOUTH STATION

The current year data (the top graph) show that the in-lake transparency ***remained stable*** between 2 and 3 meters from June to September. The transparency in all four months was ***less than*** the state mean.

The historical data (the bottom graph) show that the 2003 mean transparency is ***less than*** the state mean.

Typically, high intensity rainfall causes erosion of sediments into lakes/ponds and streams, thus decreasing clarity. Efforts should continually be made to stabilize stream banks, lake/pond shorelines, disturbed soils within the watershed, and especially dirt roads located immediately adjacent to the edge of tributaries and the lake/pond. Guides to Best Management Practices designed to reduce, and possibly even eliminate, nonpoint source pollutants, such as sediment loading, are available from DES upon request.

- **Figure 3 and Table 8:** The graphs in Figure 3 (Appendix A) show the amounts of phosphorus in the epilimnion (the upper layer) and the hypolimnion (the lower layer); the inset graphs show current year data. Table 8 (Appendix B) lists the annual maximum, minimum, and median concentration for each deep spot layer and each tributary since the lake/pond has joined the program.

Phosphorus is the limiting nutrient for plant and algae growth in New Hampshire's freshwater lakes and ponds. Too much phosphorus in a lake/pond can lead to increases in plant and algal growth over time. **The median summer total phosphorus concentration in the epilimnion (upper layer) of New Hampshire's lakes and ponds is 11 ug/L. The median summer phosphorus concentration in the hypolimnion (lower layer) is 14 ug/L.**

NORTH STATION

The current year data for the epilimnion (the top inset graph) show that the phosphorus concentration ***remained stable*** from June to September. The phosphorus concentration in June, August and September was ***less than*** the state median while the concentration in July was ***greater than*** the state median

The historical data show that the 2003 mean epilimnetic phosphorus concentration is ***approximately equal to*** the state median.

The current year data for the hypolimnion (the bottom inset graph) show that the phosphorus concentration ***remained stable*** in June, July and September but ***increased*** in July. The phosphorus concentration in June, July, and September was ***less than*** the state median while the concentration in August was ***greater than*** the state median.

The historical data show that the 2003 mean hypolimnetic phosphorus concentration is ***less than*** the state median.

SOUTH STATION
The current year data for the epilimnion (the top inset graph) show that the phosphorus concentration ***remained stable*** from June to July and September. The phosphorus concentration was not reported for August.

The historical data show that the 2003 mean epilimnetic phosphorus concentration is ***approximately equal to*** the state median.

The current year data for the hypolimnion (the bottom inset graph) show that the phosphorus concentration ***remained stable*** from June to July. The phosphorus concentration was not reported for August and September.

The historical data show that the 2003 mean hypolimnetic phosphorus concentration is ***less than*** the state median.

TABLE INTERPRETATION

- **Table 2: Phytoplankton**
  Table 2 (Appendix B) lists the current and historic phytoplankton species observed in the lake/pond.

NORTH STATION
The dominant phytoplankton species observed this year were ***Mallomonas (a golden-brown), Tabellaria (a diatom) and Dinobryon (a golden-brown).***

SOUTH STATION
The dominant phytoplankton species observed this year were ***Chrysosphaerella, Dinobryon and Mallomonas;*** which are ***all golden-brown algae.***

Phytoplankton populations undergo a natural succession during the growing season (Please refer to the "Biological Monitoring Parameters" section of this report for a more detailed explanation regarding seasonal plankton succession). Diatoms and golden-brown algae are typical in New Hampshire's less productive lakes and ponds.

- **Table 4: pH**
  Table 4 (Appendix B) presents the in-lake and tributary current year and historical pH data.

  pH is measured on a logarithmic scale of 0 (acidic) to 14 (basic). pH is important to the survival and reproduction of fish and other aquatic life. A pH below 5.5 severely limits the growth and reproduction of fish. A pH between 6.5 and 7.0 is ideal for fish. The mean pH value for the epilimnion (upper layer) in New Hampshire's lakes and ponds is **6.5**, which indicates that the surface waters in state are slightly acidic. For a more detailed explanation regarding pH, please refer to the "Chemical Monitoring Parameters" section of this report.

  NORTH STATION
  The mean pH at the deep spot this season ranged from **5.90** in the hypolimnion to **6.03** in the epilimnion, which means that the water is ***slightly acidic.***

  SOUTH STATION
  The mean pH at the deep spot this season ranged from **6.03** in the hypolimnion to **6.07** in the epilimnion, which means that the water is ***slightly acidic.***

  Due to the presence of granite bedrock in the state and the deposition of acid rain, there is not much that can be done to effectively increase lake/pond pH.

- **Table 5: Acid Neutralizing Capacity**
  Table 5 (Appendix B) presents the current year and historic epilimnetic ANC for each year the lake/pond has been monitored through VLAP.

  Buffering capacity or ANC describes the ability of a solution to resist changes in pH by neutralizing the acidic input to the lake. The mean ANC value for New Hampshire's lakes and ponds is **6.7 mg/L**, which indicates that many lakes and ponds in the state are "highly sensitive" to acidic inputs. For a more detailed explanation, please refer to the "Chemical Monitoring Parameters" section of this report.

  NORTH STATION
  The Acid Neutralizing Capacity (ANC) of the epilimnion (the upper layer) continues to remain ***much less than*** the state mean of **6.7 mg/L**. Specifically, the mean ANC was **3.50 mg/L**, which indicates

that the lake is ***critically sensitive*** to acidic inputs (such as acid precipitation).

SOUTH STATION
The Acid Neutralizing Capacity (ANC) of the epilimnion (the upper layer) continues to remain ***much less than*** the state mean of **6.7 mg/L**. Specifically, the mean ANC was **1.73 mg/L**, which indicates that the lake is ***critically sensitive*** to acidic inputs (such as acid precipitation).

- **Table 6: Conductivity**
  Table 6 (Appendix B) presents the current and historic conductivity values for tributaries and in-lake data. Conductivity is the numerical expression of the ability of water to carry an electric current. The mean conductivity value for New Hampshire's lakes and ponds is **62.1 uMhos/cm**. For a more detailed explanation, please refer to the "Chemical Monitoring Parameters" section of this report.

NORTH STATION
The north station conductivity has increased since monitoring began but is still relatively ***low*** and ***less than*** the state mean. Typically conductivity levels greater than 100 uMhos/cm indicate the influence of human activities on surface water quality. These activities include septic system leachate, agricultural runoff, iron deposits, and road runoff (which contains road salt during the spring snow melt). The low conductivity level in the **lake/pond** is an indication of the low amount of pollutants in the watershed.

SOUTH STATION
The south station conductivity is relatively ***low*** and ***less than*** the state mean. Typically conductivity levels greater than 100 uMhos/cm indicate the influence of human activities on surface water quality. These activities include septic system leachate, agricultural runoff, iron deposits, and road runoff (which contains road salt during the spring snow melt). The low conductivity level in the **lake/pond** is an indication of the low amount of pollutants in the watershed. We hope that low south station conductivity remains!

- **Table 8: Total Phosphorus**
  Table 8 (Appendix B) presents the current year and historic total phosphorus data for in-lake and tributary stations. Phosphorus is the nutrient that limits the algae's ability to grow and reproduce. Please refer to the "Chemical Monitoring Parameters" section of this report for a more detailed explanation.

Several north and south station tributaries were sampled for phosphorus this season. The phosphorus concentration in the samples was ***relatively low***. We hope this continues.

- **Table 9 and Table 10: Dissolved Oxygen and Temperature Data**
  Table 9 (Appendix B) shows the dissolved oxygen/temperature profile(s) for the 2003 sampling season. Table 10 (Appendix B) shows the historical and current year dissolved oxygen concentration in the hypolimnion (lower layer). The presence of dissolved oxygen is vital to fish and amphibians in the water column and also to bottom-dwelling organisms. Please refer to the "Chemical Monitoring Parameters" section of this report for a more detailed explanation.

  The dissolved oxygen concentration was ***low in the hypolimnion*** at the both deep spot of the lake/pond. As stratified lakes/ponds age, oxygen becomes ***depleted*** in the hypolimnion (the lower layer) by the process of decomposition. Specifically, the loss of oxygen in the hypolimnion results primarily from the process of biological breakdown of organic matter (i.e.; biological organisms use oxygen to break down organic matter), both in the water column and particularly at the bottom of the lake/pond where the water meets the sediment. When oxygen levels are depleted to less than 1 mg/L in the hypolimnion **(as it was this season and in many past seasons)**, the phosphorus that is normally bound up in the sediment may be re-released into the water column.

  The ***low*** oxygen level in the hypolimnion is a sign of the lake's/pond's ***aging*** and ***declining*** health. This year the DES biologist conducted the temperature/dissolved oxygen profile in ***August.*** We recommend that the annual biologist visit for the 2004 sampling season be scheduled during ***June or July*** so that we can determine if oxygen is depleted in the hypolimnion ***earlier*** in the sampling season.

- **Table 11: Turbidity**
  Table 11 (Appendix B) lists the current year and historic data for in-lake and tributary turbidity. Turbidity in the water is caused by suspended matter, such as clay, silt, and algae. Water clarity is strongly influenced by turbidity. Please refer to the "Other Monitoring Parameters" section of this report for a more detailed explanation.

  Several north and south station in-lake and tributaries were sampled for turbidity this season. The turbidity in the samples was ***relatively low***. We hope this continues.

DATA QUALITY ASSURANCE AND CONTROL

Annual Assessment Audit:

The DES biologist did not conduct a "Sampling Procedures Assessment Audit" for your monitoring group in 2003 since your monitoring group did not sample the deep spots during the annual biologist visit. We recommend that the annual biologist visit be scheduled for a deep spot sampling event. This assessment is used to identify any aspects of sample collection in which volunteer monitors are not following the proper procedures, and also provides an opportunity for the biologist to retrain the volunteer monitors as necessary. This will ultimately ensure that the samples that the volunteer monitors collect are truly representative of actual lake and tributary conditions.

Sample Receipt Checklist

Each time your monitoring group dropped off samples at the laboratory this summer, the laboratory staff completed a sample receipt checklist to assess and document if the volunteer monitors followed proper sampling techniques when collecting the samples. The purpose of the sample receipt checklist is to minimize, and hopefully eliminate, future re-occurrences of improper sampling techniques.

Overall, the sample receipt checklist showed that your monitoring group did a ***very good*** job when collecting samples this season! Specifically, the members of your monitoring group followed the majority of the proper field sampling procedures when collecting and submitting samples to the laboratory. ***However***, on 9/14/03 a big white bottle was not submitted for the ***north station*** metalimnion and not enough sample water was collected form several ***north station*** tributaries. In addition, no ***south station*** samples were submitted on 8/17/03 and no phosphorus samples were submitted for the hypolimnion on 9/14/03.

The following is a list of sample quality control aspects reviewed by DES:

- **Sample Holding Time:** Please remember to return samples to the laboratory **within 24 hours of sample collection**. This will ensure that samples do not degrade before they are analyzed. If you plan to sample on the weekend, please sample on Sunday, preferably in the afternoon, and return samples to the lab first thing on Monday morning to ensure that samples can be analyzed within 24 hours. ***E.coli* samples that are more than 24 hours old will not be accepted by the laboratory for analysis.**

- **Sample "Cooling":** Please remember to bring a cooler with ice when you sample. Samples should be put directly into the cooler and kept on ice until they are dropped off at the laboratory. This will ensure that samples do not degrade before they are analyzed. If you plan to sample on the weekend, please sample on Sunday, preferably in the afternoon, and return samples to the lab first thing on Monday morning to ensure that samples can be analyzed within 24 hours. **And, please remember that *E.coli* samples that are more than 24 hours old will not be accepted by the laboratory for analysis.**

- **Sample Labeling:** Please make sure to label your samples with a waterproof pen (a black sharpie permanent marker works best), preferably before sampling. Make sure that the ink does not wash off the bottle when exposed to water. If your association has made its own sample bottle labels, please make sure to fold over one corner of each label before placing it on a sample bottle so that the label will not become permanently attached to the bottle. In addition, please make sure that the labels will stick to the bottles when they are wet.

- **Tributary Sampling:** Please do not sample tributaries that are not flowing. Due to the lack of flushing, stagnant water typically contains elevated amounts of chemical and biological constituents that will lead to erroneous results.

<u>NOTES</u>

NORTH STATION

- **Biologist's Note (9/14/03):** No big white bottle submitted for Metalimnion; so no cond., pH, or turb. Carr Brook East of Shed Hill and Pickerel Cove Brook: not enough water In sample bottle to test for pH, cond., And turb.

- **Monitor's Note (6/15/03):** Lake water temp. was cooler than normal years. Tributaries feeding into the lake are higher than normal years due to excessive rainfall this spring. Dead Brook, lower end of lake, the current was running from the lake into Dead Brook

  (8/18/03): No secchi reading today.

SOUTH STATION

- **Biologist's Note (8/17/03):** No south station samples were submitted for analysis.
  (9/14/03): No phosphorous sample submitted for analysis for hypolimnion.

- **Monitor's Note (8/17/03):** Had much boat traffic by 10 AM. Water was churned. Dam- did chlorophyll-a sample with tube at 3m. Lake at high level; considerable amount of rain.
  (8/18/03): Rain early in week raised lake up 5-6 inches. Rain yesterday also.

USEFUL RESOURCES

Best Management Practices to Control Nonpoint Source Pollution: A Guide for Citizens and Town Officials, *NHDES-WD 97-8*, NHDES Booklet, (603) 271-3503.

Camp Road Maintenance Manual: A Guide for Landowners. KennebecSoil and Water Conservation District, 1992, (207) 287-3901.

Comprehensive Shoreland Protection Act, RSA 483-B, *WD-SP-5,* NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/sp/sp-5.htm.

Cyanobacteria in New Hampshire Waters Potential Dangers of Blue-Green Algae Blooms, NHDES Fact Sheet, (603) 271-3505, or www.des.state.nh.us/factsheets/wmb/wmb-10.htm.

Erosion Control for Construction in the Protected Shoreland Buffer Zone, WD-SP-1, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/sp/sp-1.htm

Impacts of Development Upon Stormwater Runoff, WD-WQE-7, NHDES Fact Sheet, (603) 271-3503, or www.des.state.nh.us/factsheets/wqe/wqe-7.htm

Iron Bacteria in Surface Water, *WD-BB-18*, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/bb/bb-18.htm

Lake Protection Tips: Some Do's and Don'ts for Maintaining Healthy Lakes, *WD-BB-9*, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/bb/bb-9.htm.

Management of Canada Geese in Suburban Areas: A Guide to the Basics, Draft Report, NJ Department of Environmental Protection Division of Watershed Management, March 2001, www.state.nj.us/dep/watershedmgt/DOCS/BMP_DOCS/Goosedraft.pdf.

Proper Lawn Care In the Protected Shoreland, The Comprehensive Shoreland Protection Act, WD-SP-2, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/sp/sp-2.htm.

Road Salt and Water Quality, WD-WMB-4, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/wmb/wmb-4.htm.

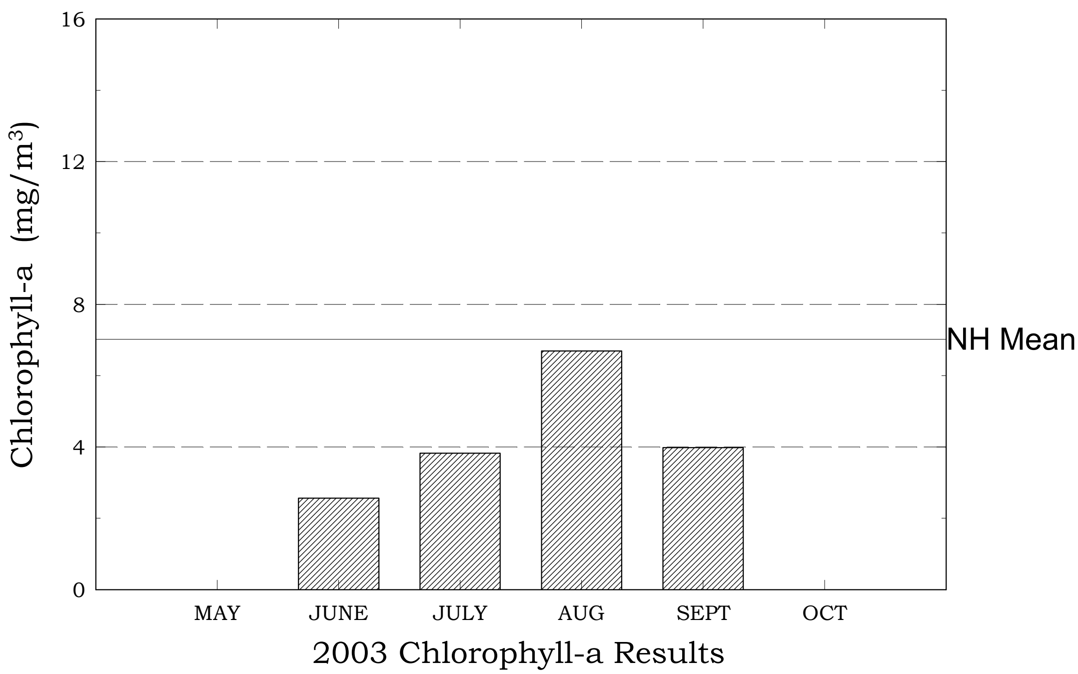
Sand Dumping - Beach Construction, *WD-BB-15*, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/bb/bb-15.htm.

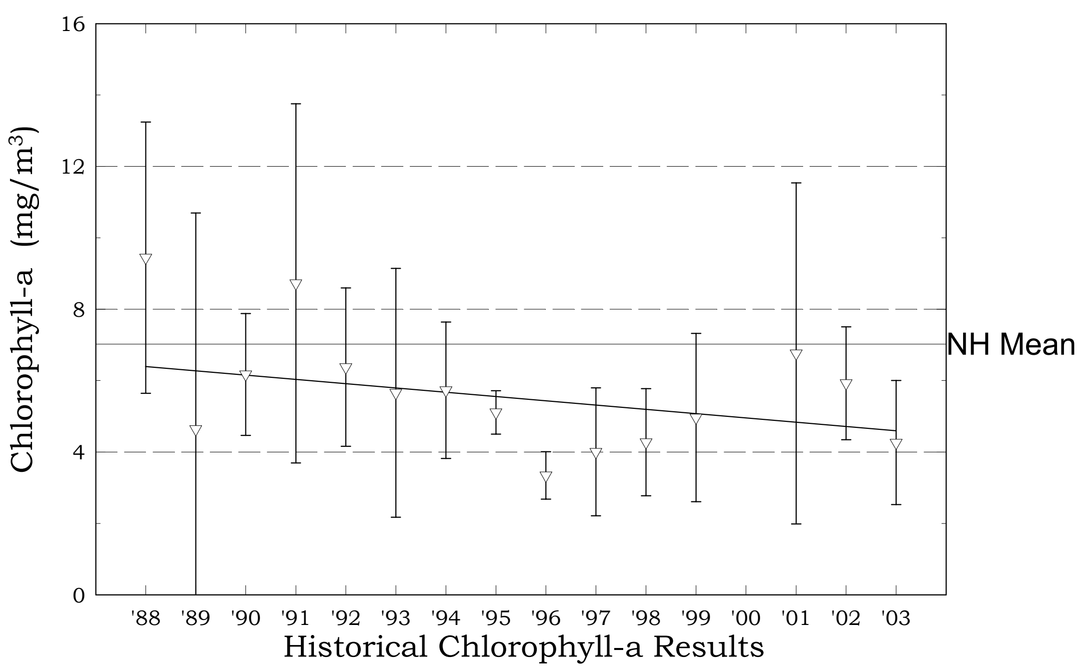
APPENDIX A

GRAPHS

Highland Lake, North, Stoddard

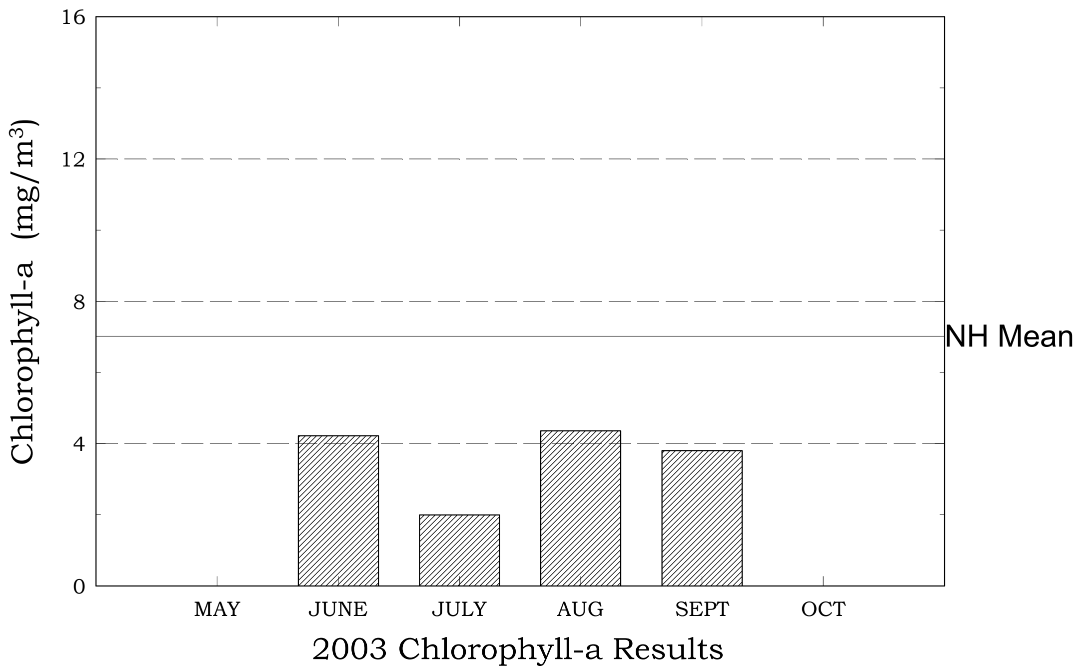
Figure 1. Monthly and Historical Chlorophyll-a Results

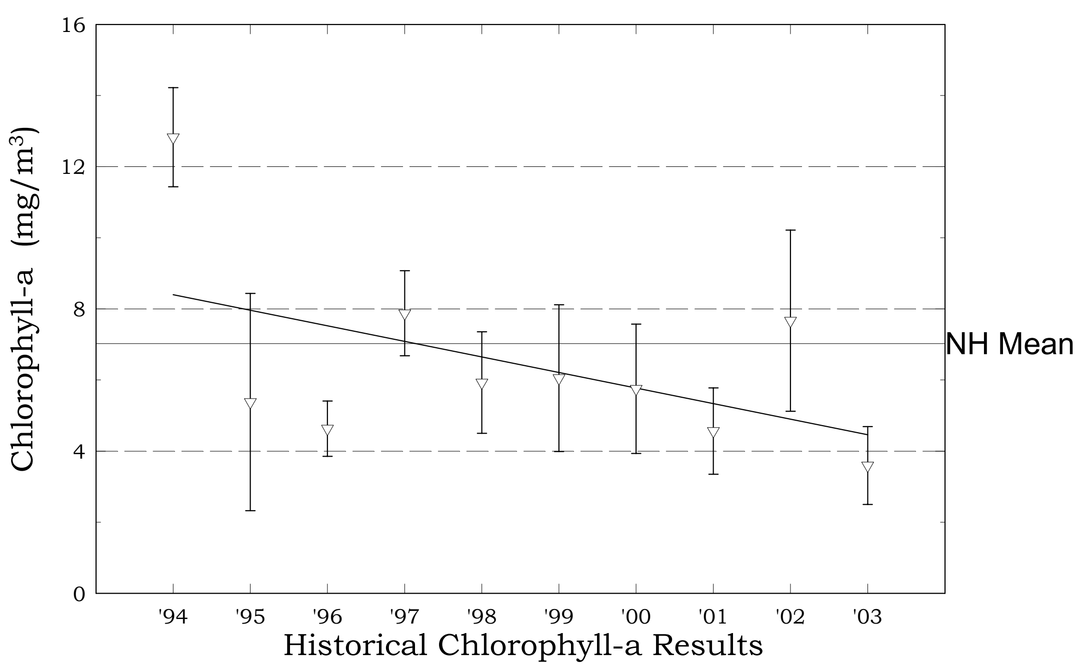




Highland Lake, South, Stoddard

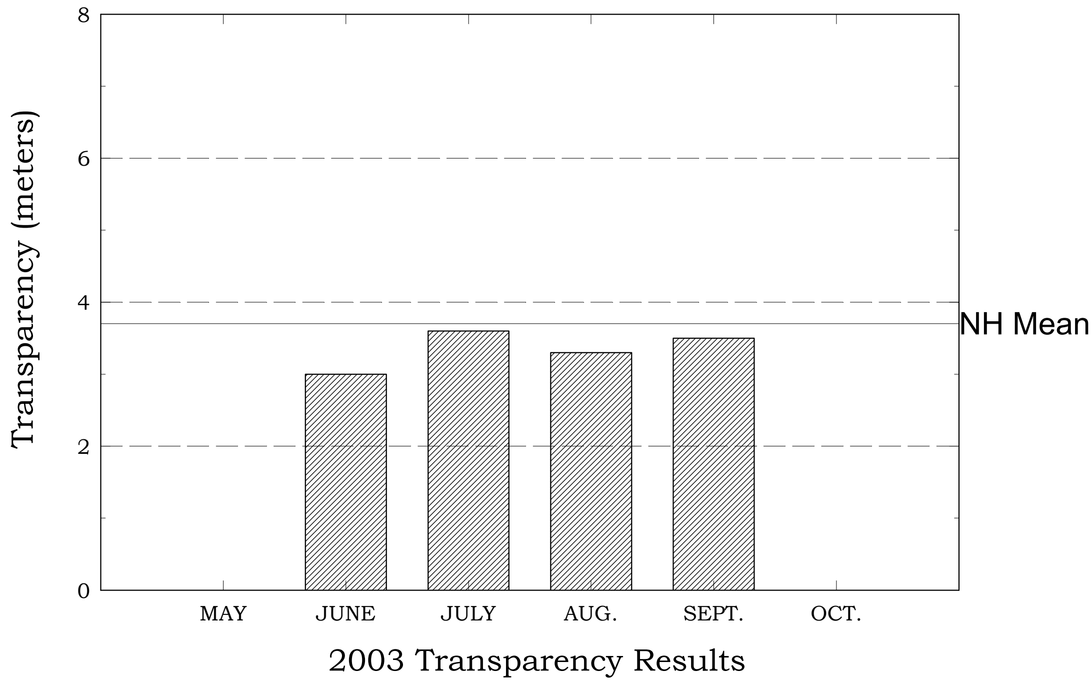
Figure 1. Monthly and Historical Chlorophyll-a Results

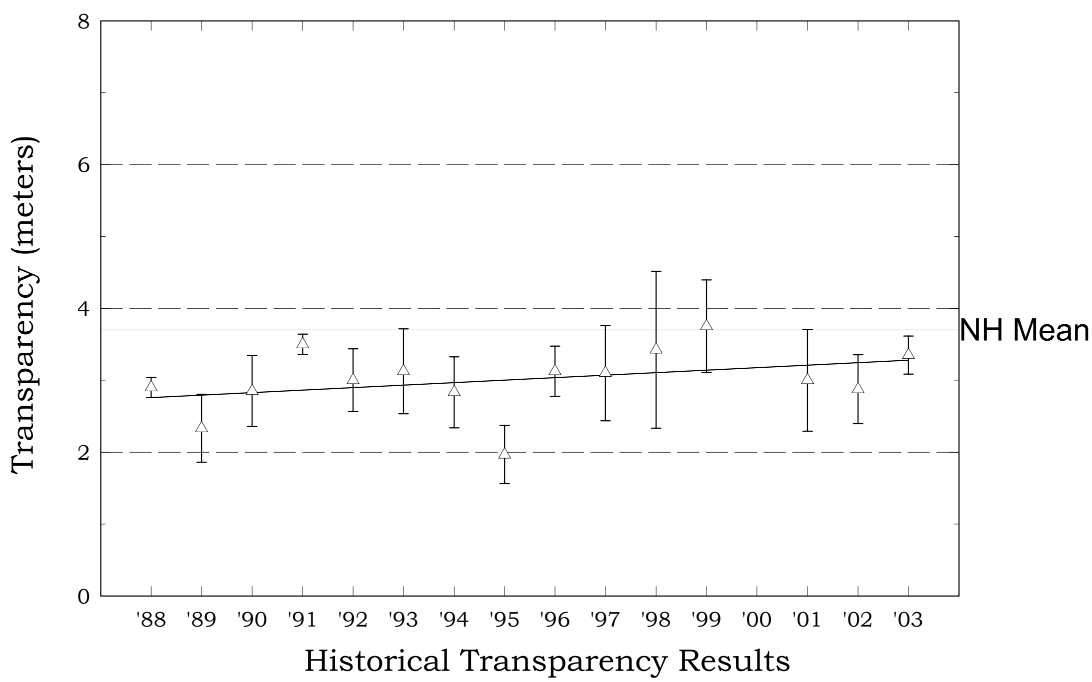




Highland Lake, North, Stoddard

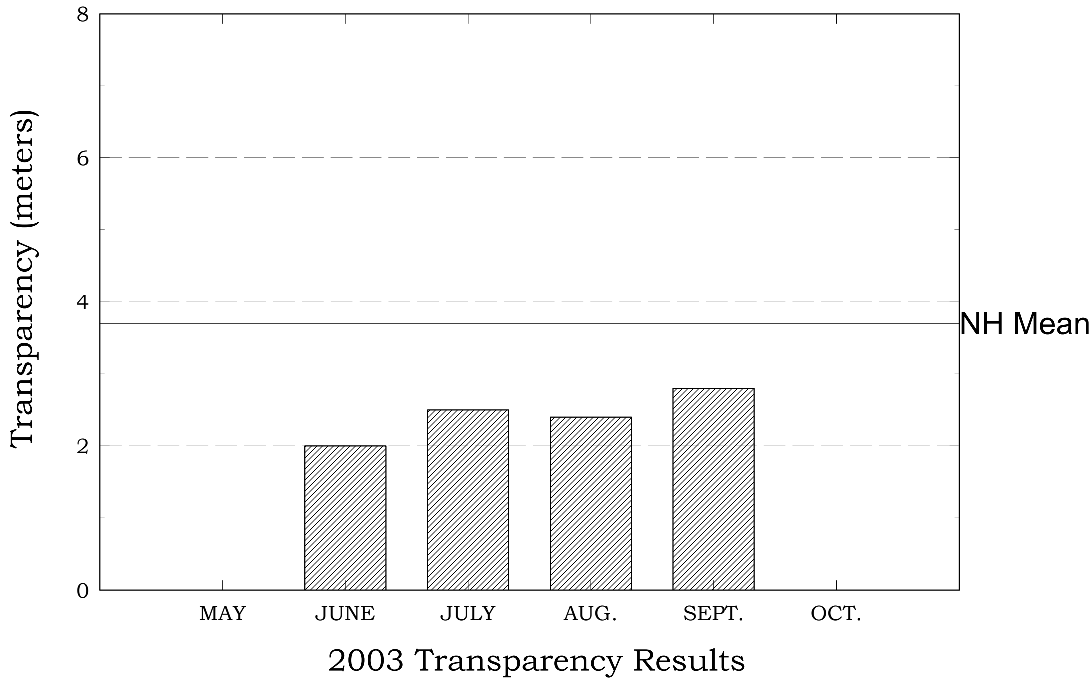
Figure 2. Monthly and Historical Transparency Results

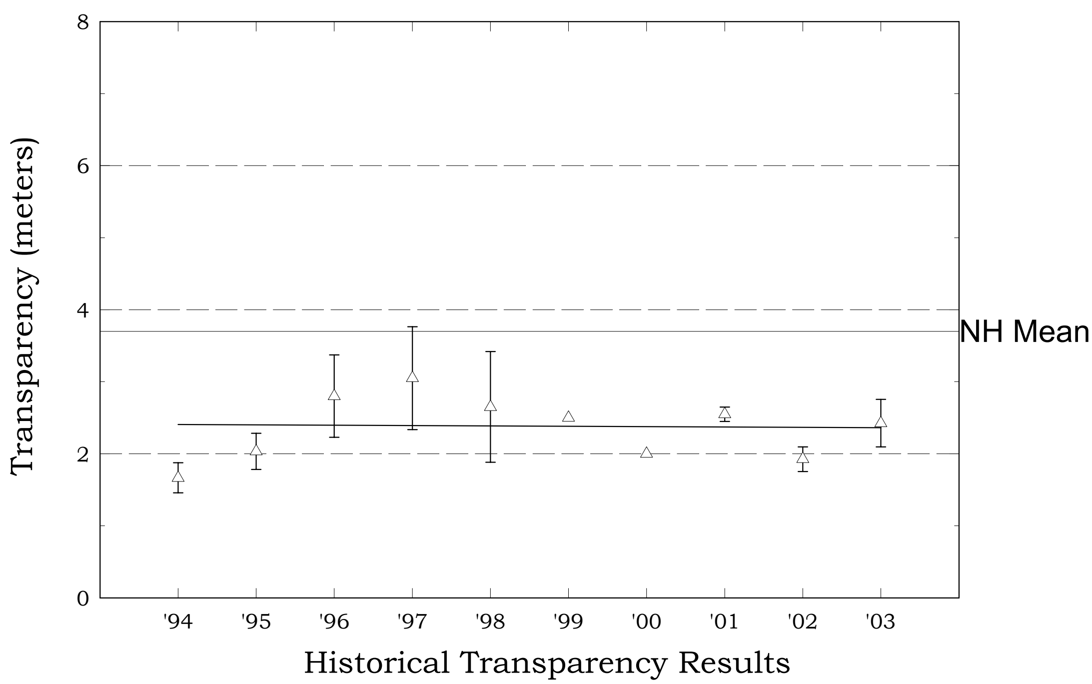




Highland Lake, South, Stoddard

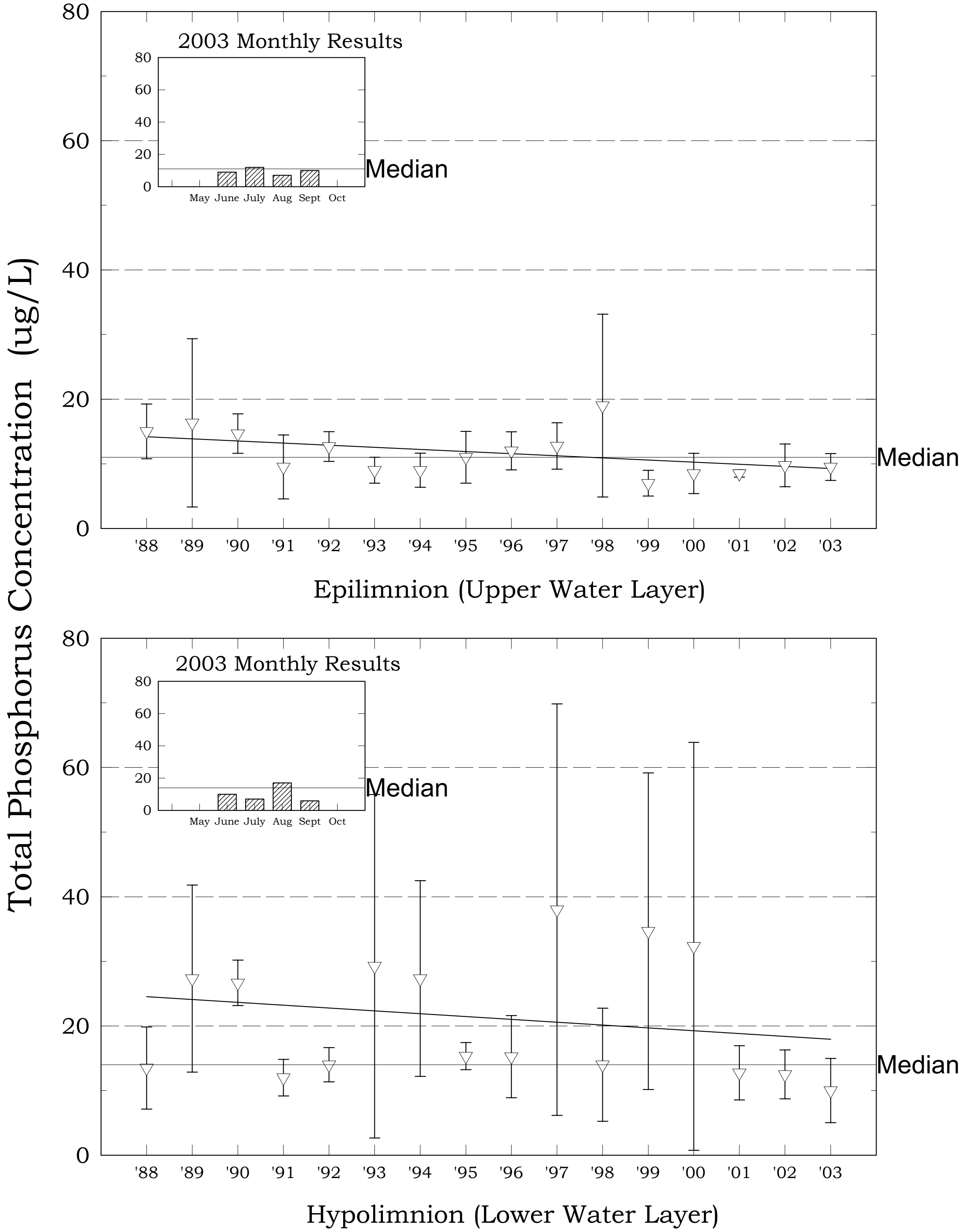
Figure 2. Monthly and Historical Transparency Results





Highland Lake, North, Stoddard

Figure 3. Monthly and Historical Total Phosphorus Data.



Highland Lake, South, Stoddard

Figure 3. Monthly and Historical Total Phosphorus Data.